

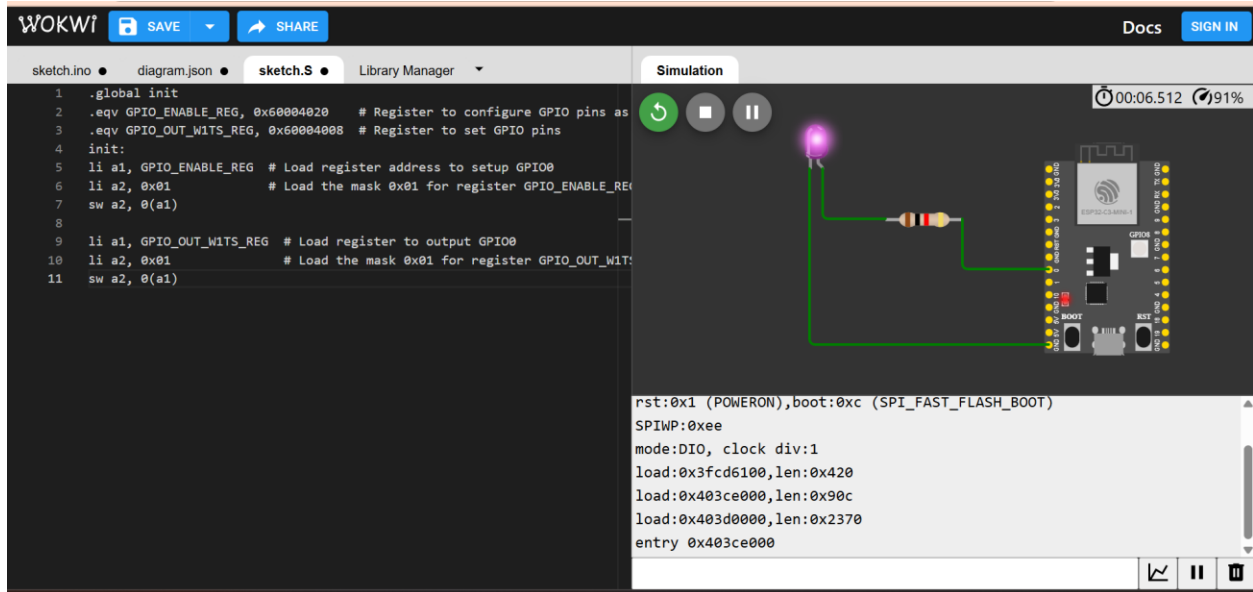
Student name: Lê Ngọc Anh Vũ

Student ID: 20236014

Lab 13

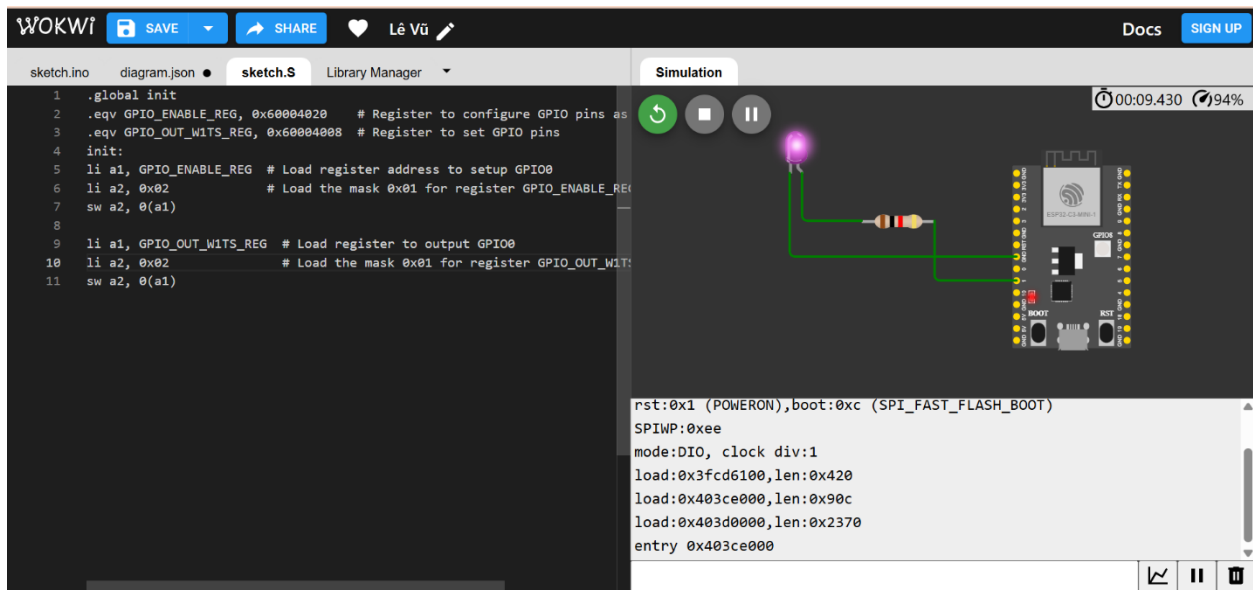
Assignment 1: Create a project to implement and test Home Assignment 1. Update the source code to test with other GPIO pins (GPIO2, GPIO3, GPIO4).

The result of implementing test Home Assignment 1:

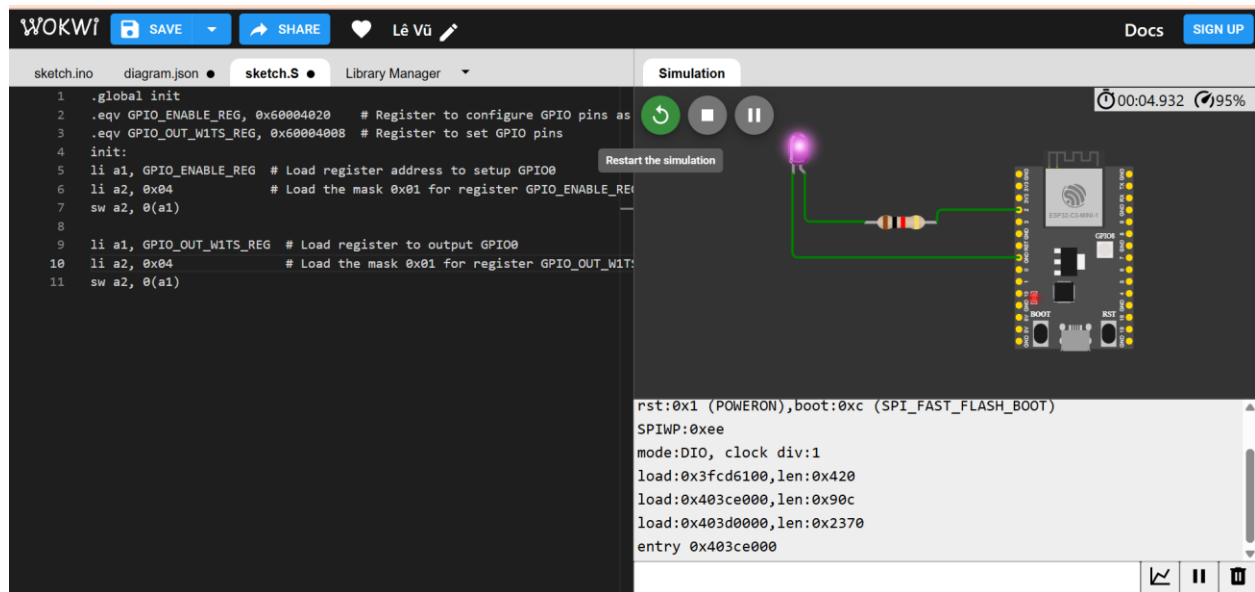


Update the source code to test with:

- GPIO1 pin:

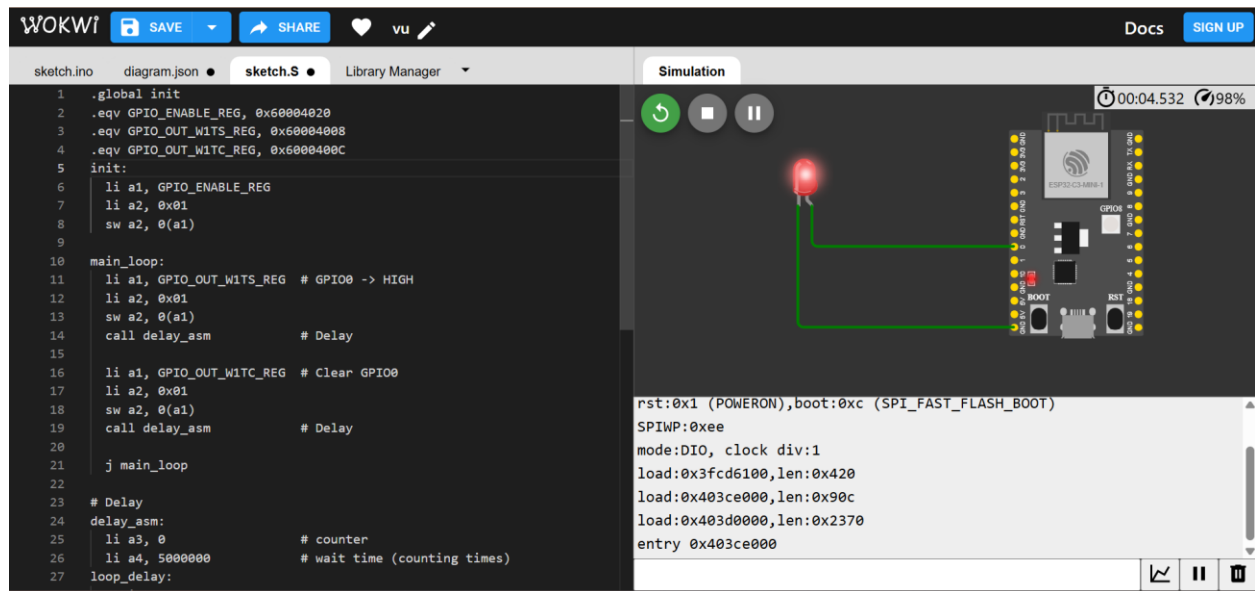


- GPIO2 pin:



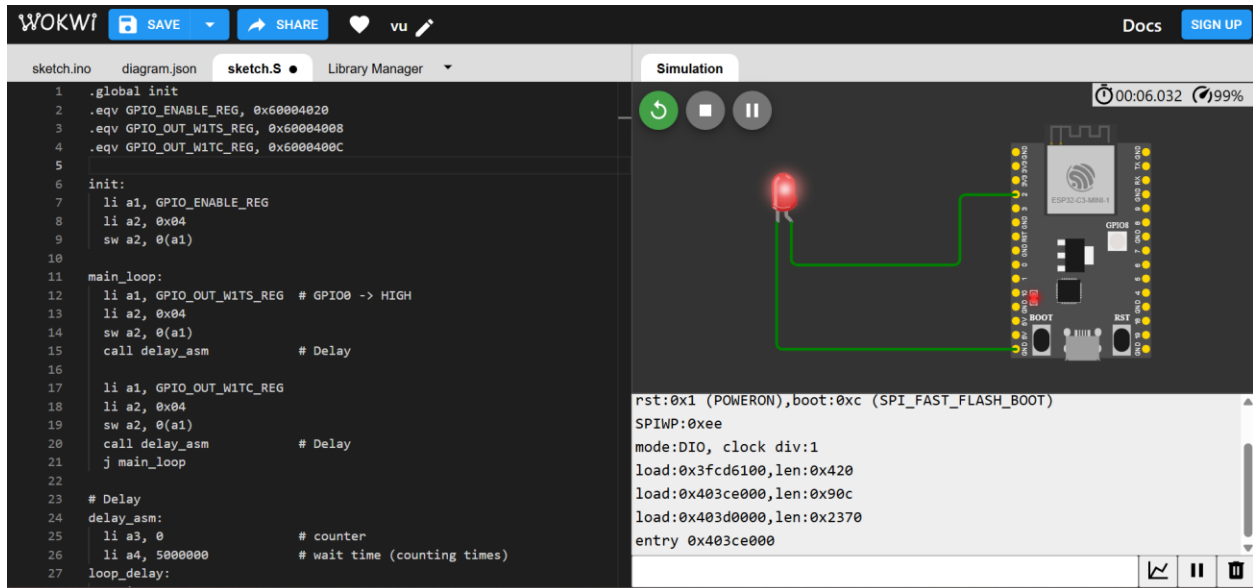
Assignment 2: Create a project to implement and test Home Assignment 2. Update the source code to test with other GPIO pins (GPIO2, GPIO3, GPIO4) and adjust the LED blinking duration.

Implementing and testing Home Assignment 2:

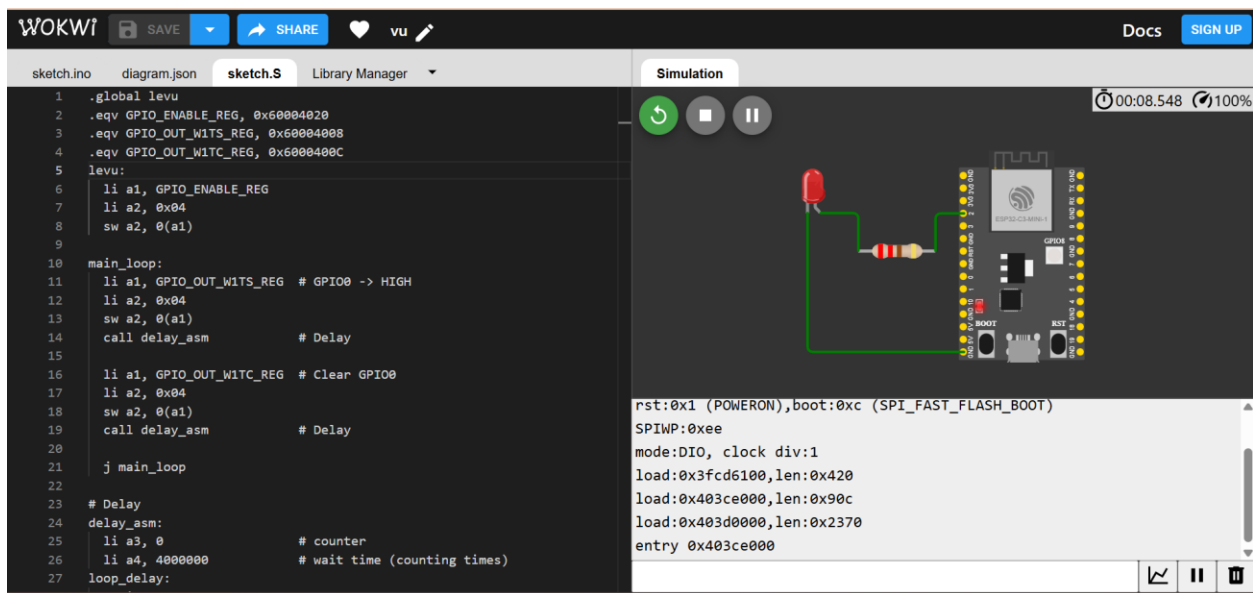


Update the source code to test with:

- GPIO2 pin:

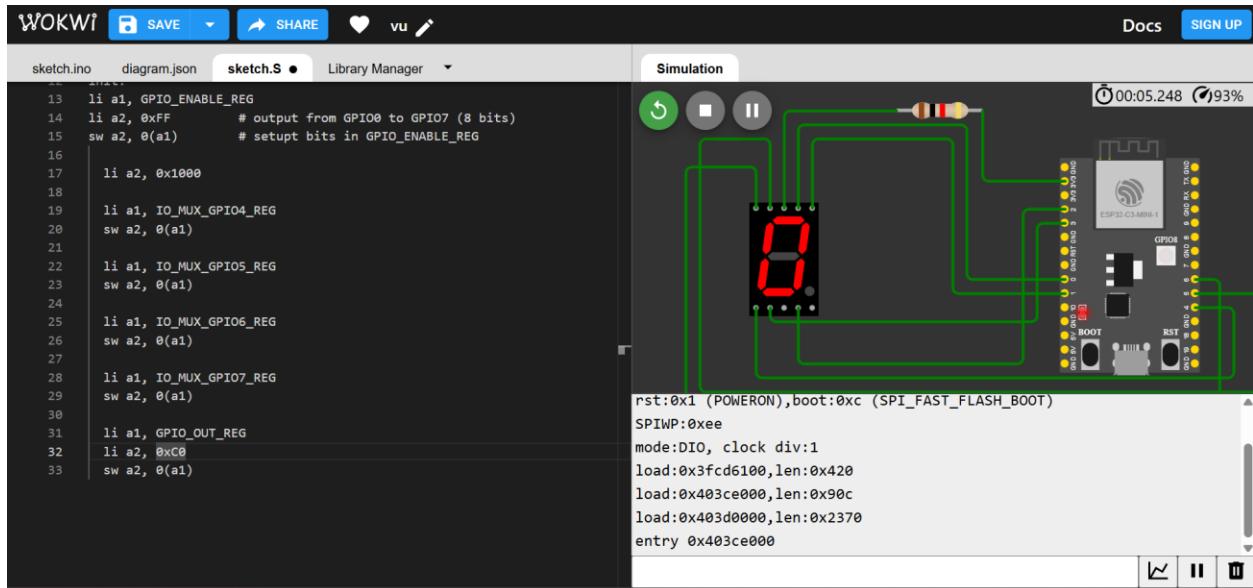


- Adjusting the LED blinking duration:

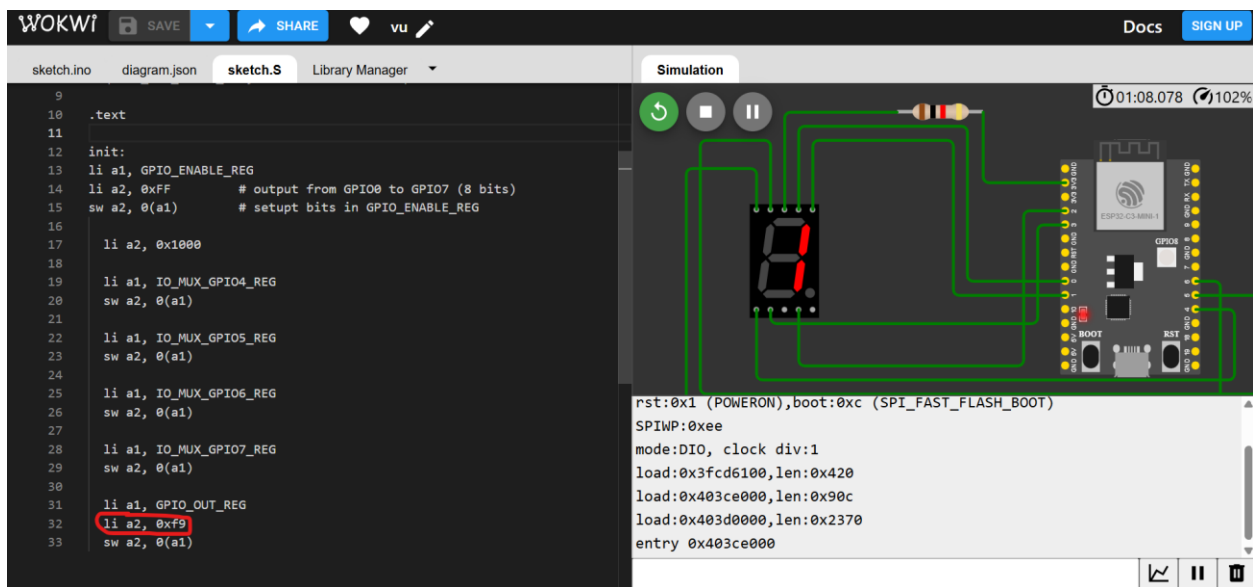


Assignment 3: Create a project to implement and test Home Assignment 3. Update the source code to display different digits (from 0 to 9).

Implementing and testing Home Assignment 3:



Update source code to display digit 1:



Assignment 4: Create a project to implement and test Home Assignment 4. Update the source code to use other GPIO pins (GPIO2, GPIO3, GPIO4) as signal input pins.

Implementing and testing Home Assignment 4:

- Turn off the LED:

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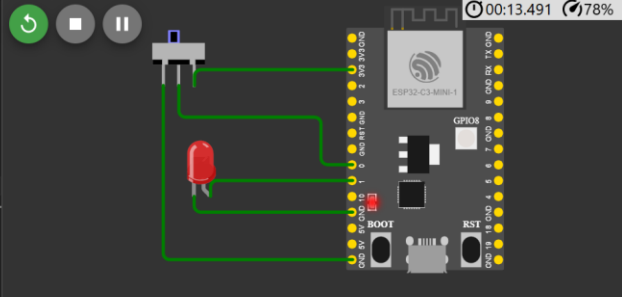
sketch.ino diagram.json **sketch.S** Library Manager

```

17 sw a2, 0(a1)
18 loop:
19 li a1, GPIO_IN_REG
20 # Read status of GPIO
21 lw a2, 0(a1)
22 andi a3, a2, 0x01
23 # Check GPIO0
24 beq a3, zero, clear # If GPIO0 = 0 => turn off LED
25 set:
26 li a1, GPIO_OUT_W1TS_REG # turn on LED: Set GPIO1 = 1
27 li a2, 0x02
28 sw a2, 0(a1)
29 j next
30 clear:
31 li a1, GPIO_OUT_W1TC_REG # off LED: Clear GPIO1 = 0
32 li a2, 0x02
33 sw a2, 0(a1)
34 next:
35 j loop
36 # Loop

```

Simulation



00:13.491 78%

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

- Turn on the LED:

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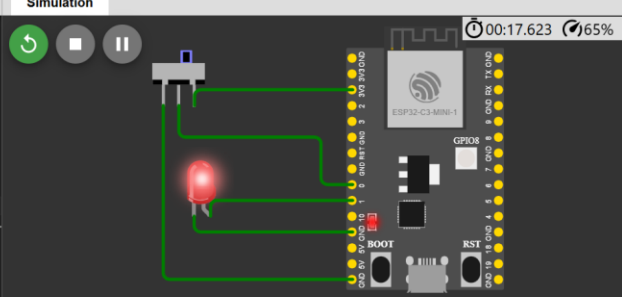
sketch.ino diagram.json **sketch.S** Library Manager

```

17 sw a2, 0(a1)
18 loop:
19 li a1, GPIO_IN_REG
20 # Read status of GPIO
21 lw a2, 0(a1)
22 andi a3, a2, 0x01
23 # Check GPIO0
24 beq a3, zero, clear # If GPIO0 = 0 => turn off LED
25 set:
26 li a1, GPIO_OUT_W1TS_REG # turn on LED: Set GPIO1 = 1
27 li a2, 0x02
28 sw a2, 0(a1)
29 j next
30 clear:
31 li a1, GPIO_OUT_W1TC_REG # off LED: Clear GPIO1 = 0
32 li a2, 0x02
33 sw a2, 0(a1)
34 next:
35 j loop
36 # Loop

```

Simulation



00:17.623 65%

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

Update the source code to use GPIO2 pin:

- Turn off the LED:

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sketch.ino diagram.json **sketch.S** Library Manager

```

1 .global init
2
3 .eqv GPIO_OUT_W1TS_REG, 0x60004008 # set register
4 .eqv GPIO_OUT_W1TC_REG, 0x6000400C # clear register
5 .eqv GPIO_ENABLE_REG, 0x60004020 # enable output register
6 .eqv GPIO_IN_REG, 0x6000403C # state register GPIO
7 .eqv IO_MUX_GPIO0_REG, 0x60009004 # function register GPIO0
8
9 init:
10  li a1, GPIO_ENABLE_REG
11  li a2, 0x04
12  sw a2, 0(a1)
13  li a1, IO_MUX_GPIO0_REG # Enable GPIO0 as input
14
15  lw a2, 0(a1)
16  ori a2, a2, 0x200
17  sw a2, 0(a1)
18
19 loop:
20  li a1, GPIO_IN_REG # Read status of GPIO
21  lw a2, 0(a1)
22  andi a3, a2, 0x01
23
24  # Check GPIO0
25  beq a3, zero, clear # If GPIO0 = 0 => turn off LED
26  set:
27  li a1, GPIO_OUT_W1TS_REG

```

Simulation

00:20.639 71%

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
 SPIWP:0xee
 mode:DIO, clock div:1
 load:0x3fcd6100,len:0x420
 load:0x403ce000,len:0x90c
 load:0x403d0000,len:0x2370
 entry 0x403ce000

- Turn on the LED:

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sketch.ino diagram.json **sketch.S** Library Manager

```

1 .global init
2
3 .eqv GPIO_OUT_W1TS_REG, 0x60004008 # set register
4 .eqv GPIO_OUT_W1TC_REG, 0x6000400C # clear register
5 .eqv GPIO_ENABLE_REG, 0x60004020 # enable output register
6 .eqv GPIO_IN_REG, 0x6000403C # state register GPIO
7 .eqv IO_MUX_GPIO0_REG, 0x60009004 # function register GPIO0
8
9 init:
10  li a1, GPIO_ENABLE_REG
11  li a2, 0x04
12  sw a2, 0(a1)
13  li a1, IO_MUX_GPIO0_REG # Enable GPIO0 as input
14
15  lw a2, 0(a1)
16  ori a2, a2, 0x200
17  sw a2, 0(a1)
18
19 loop:
20  li a1, GPIO_IN_REG # Read status of GPIO
21  lw a2, 0(a1)
22  andi a3, a2, 0x01
23
24  # Check GPIO0
25  beq a3, zero, clear # If GPIO0 = 0 => turn off LED
26  set:
27  li a1, GPIO_OUT_W1TS_REG

```

Simulation

00:24.837 82%

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
 SPIWP:0xee
 mode:DIO, clock div:1
 load:0x3fcd6100,len:0x420
 load:0x403ce000,len:0x90c
 load:0x403d0000,len:0x2370
 entry 0x403ce000

Assignment 5: Create a project to implement a circuit that counts from 0 to 9 on a 7-segment LED display

Counting from 0 to 9:

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sketch.ino
diagram.json
sketch.S
Library Manager

10
init:
18
li a1, IO_MUX_GPIO4_REG
19
sw a2, 0(a1)
20
li a1, IO_MUX_GPIO5_REG
21
sw a2, 0(a1)
22
li a1, IO_MUX_GPIO6_REG
23
sw a2, 0(a1)
24
li a1, IO_MUX_GPIO7_REG
25
sw a2, 0(a1)
26
27
28
main_loop:
29
li a1, GPIO_OUT_REG
30
li a2, 0xc0
31
sw a2, 0(a1) # Output to GPIO
32
call delay_asm # Delay
33
34
35
li a1, GPIO_OUT_REG
36
li a2, 0xf9
37
sw a2, 0(a1) # Output to GPIO
38
call delay_asm # Delay
39
40
41
li a1, GPIO_OUT_REG
42
li a2, 0xa4
43
sw a2, 0(a1) # Output to GPIO
44
call delay_asm # Delay

Simulation
00:00.299 0%
Restart the simulation

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

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Docs
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sketch.ino
diagram.json
sketch.S
Library Manager

10
init:
18
li a1, IO_MUX_GPIO4_REG
19
sw a2, 0(a1)
20
li a1, IO_MUX_GPIO5_REG
21
sw a2, 0(a1)
22
li a1, IO_MUX_GPIO6_REG
23
sw a2, 0(a1)
24
li a1, IO_MUX_GPIO7_REG
25
sw a2, 0(a1)
26
27
28
main_loop:
29
li a1, GPIO_OUT_REG
30
li a2, 0xc0
31
sw a2, 0(a1) # Output to GPIO
32
call delay_asm # Delay
33
34
35
li a1, GPIO_OUT_REG
36
li a2, 0xf9
37
sw a2, 0(a1) # Output to GPIO
38
call delay_asm # Delay
39
40
41
li a1, GPIO_OUT_REG
42
li a2, 0xa4
43
sw a2, 0(a1) # Output to GPIO
44
call delay_asm # Delay

Simulation
00:14.014 99%

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

WOKWI
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Docs
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sketch.ino
diagram.json
sketch.S
Library Manager

```

10
18  init:
19    li a1, IO_MUX_GPIO4_REG
20    sw a2, 0(a1)
21    li a1, IO_MUX_GPIO5_REG
22    sw a2, 0(a1)
23    li a1, IO_MUX_GPIO6_REG
24    sw a2, 0(a1)
25    li a1, IO_MUX_GPIO7_REG
26    sw a2, 0(a1)
27
28  main_loop:
29    li a1, GPIO_OUT_REG
30    li a2, 0xc0
31    sw a2, 0(a1) # Output to GPIO
32    call delay_asm      # Delay
33
34
35    li a1, GPIO_OUT_REG
36    li a2, 0xf9
37    sw a2, 0(a1) # Output to GPIO
38    call delay_asm      # Delay
39
40
41    li a1, GPIO_OUT_REG
42    li a2, 0xa4
43    sw a2, 0(a1) # Output to GPIO
44    call delay_asm      # Delay

```

Simulation
00:01.716 99%
Restart the simulation

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

WOKWI
SAVE
SHARE
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Docs
SIGN IN

sketch.ino
diagram.json
sketch.S
Library Manager

```

10
18  init:
19    li a1, IO_MUX_GPIO4_REG
20    sw a2, 0(a1)
21    li a1, IO_MUX_GPIO5_REG
22    sw a2, 0(a1)
23    li a1, IO_MUX_GPIO6_REG
24    sw a2, 0(a1)
25    li a1, IO_MUX_GPIO7_REG
26    sw a2, 0(a1)
27
28  main_loop:
29    li a1, GPIO_OUT_REG
30    li a2, 0xc0
31    sw a2, 0(a1) # Output to GPIO
32    call delay_asm      # Delay
33
34
35    li a1, GPIO_OUT_REG
36    li a2, 0xf9
37    sw a2, 0(a1) # Output to GPIO
38    call delay_asm      # Delay
39
40
41    li a1, GPIO_OUT_REG
42    li a2, 0xa4
43    sw a2, 0(a1) # Output to GPIO
44    call delay_asm      # Delay

```

Simulation
00:08.865 100%
Stop the simulation

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```


WOKWI

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SHARE

vu

Docs

SIGN UP

sketch.ino

diagram.json

sketch.S

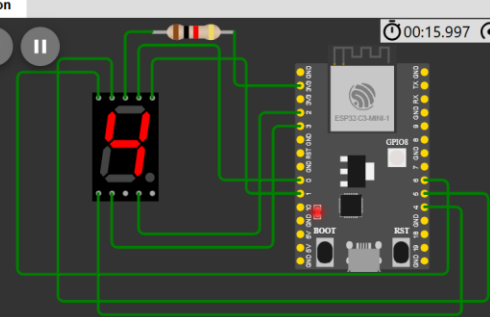
Library Manager

```
10 init:
18 li a1, IO_MUX_GPIO4_REG
19 sw a2, 0(a1)
20 li a1, IO_MUX_GPIO5_REG
21 sw a2, 0(a1)
22 li a1, IO_MUX_GPIO6_REG
23 sw a2, 0(a1)
24 li a1, IO_MUX_GPIO7_REG
25 sw a2, 0(a1)
26
27
28 main_loop:
29 li a1, GPIO_OUT_REG
30 li a2, 0xc0
31 sw a2, 0(a1) # Output to GPIO
32 call delay_asm # Delay
33
34
35 li a1, GPIO_OUT_REG
36 li a2, 0xf9
37 sw a2, 0(a1) # Output to GPIO
38 call delay_asm # Delay
39
40
41 li a1, GPIO_OUT_REG
42 li a2, 0xa4
43 sw a2, 0(a1) # Output to GPIO
44 call delay_asm # Delay
```

Simulation

00:15.997

99%



rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)

SPIWP:0xee

mode:DIO, clock div:1

load:0x3fcd6100,len:0x420

load:0x403ce000,len:0x90c

load:0x403d0000,len:0x2370

entry 0x403ce000

WOKWI

SAVE

SHARE

vu

Docs

SIGN IN

sketch.ino

diagram.json

sketch.S

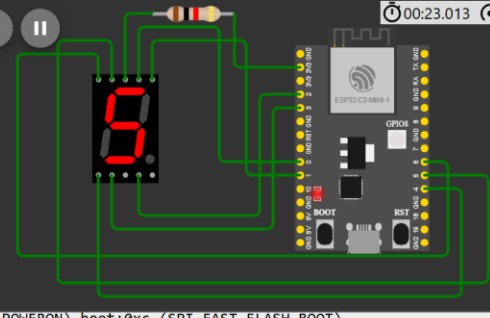
Library Manager

```
10 init:
18 li a1, IO_MUX_GPIO4_REG
19 sw a2, 0(a1)
20 li a1, IO_MUX_GPIO5_REG
21 sw a2, 0(a1)
22 li a1, IO_MUX_GPIO6_REG
23 sw a2, 0(a1)
24 li a1, IO_MUX_GPIO7_REG
25 sw a2, 0(a1)
26
27
28 main_loop:
29 li a1, GPIO_OUT_REG
30 li a2, 0xc0
31 sw a2, 0(a1) # Output to GPIO
32 call delay_asm # Delay
33
34
35 li a1, GPIO_OUT_REG
36 li a2, 0xf9
37 sw a2, 0(a1) # Output to GPIO
38 call delay_asm # Delay
39
40
41 li a1, GPIO_OUT_REG
42 li a2, 0xa4
43 sw a2, 0(a1) # Output to GPIO
44 call delay_asm # Delay
```

Simulation

00:23.013

99%



rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)

SPIWP:0xee

mode:DIO, clock div:1

load:0x3fcd6100,len:0x420

load:0x403ce000,len:0x90c

load:0x403d0000,len:0x2370

entry 0x403ce000

WOKWI

SAVE

SHARE

vu

Docs

SIGN UP

sketch.ino

diagram.json

sketch.S

Library Manager

```

10  init:
18    li a1, IO_MUX_GPIO4_REG
19    sw a2, 0(a1)
20    li a1, IO_MUX_GPIO5_REG
21    sw a2, 0(a1)
22    li a1, IO_MUX_GPIO6_REG
23    sw a2, 0(a1)
24    li a1, IO_MUX_GPIO7_REG
25    sw a2, 0(a1)
26
27
28  main_loop:
29    li a1, GPIO_OUT_REG
30    li a2, 0xc0
31    sw a2, 0(a1) # Output to GPIO
32    call delay_asm      # Delay
33
34
35    li a1, GPIO_OUT_REG
36    li a2, 0xf9
37    sw a2, 0(a1) # Output to GPIO
38    call delay_asm      # Delay
39
40
41    li a1, GPIO_OUT_REG
42    li a2, 0xa4
43    sw a2, 0(a1) # Output to GPIO
44    call delay_asm      # Delay

```

Simulation

00:30.278

99%

Stop the simulation

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

WOKWI

SAVE

SHARE

vu

Docs

SIGN UP

sketch.ino

diagram.json

sketch.S

Library Manager

```

10  init:
18    li a1, IO_MUX_GPIO4_REG
19    sw a2, 0(a1)
20    li a1, IO_MUX_GPIO5_REG
21    sw a2, 0(a1)
22    li a1, IO_MUX_GPIO6_REG
23    sw a2, 0(a1)
24    li a1, IO_MUX_GPIO7_REG
25    sw a2, 0(a1)
26
27
28  main_loop:
29    li a1, GPIO_OUT_REG
30    li a2, 0xc0
31    sw a2, 0(a1) # Output to GPIO
32    call delay_asm      # Delay
33
34
35    li a1, GPIO_OUT_REG
36    li a2, 0xf9
37    sw a2, 0(a1) # Output to GPIO
38    call delay_asm      # Delay
39
40
41    li a1, GPIO_OUT_REG
42    li a2, 0xa4
43    sw a2, 0(a1) # Output to GPIO
44    call delay_asm      # Delay

```

Simulation

00:37.477

98%

Stop the simulation

```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

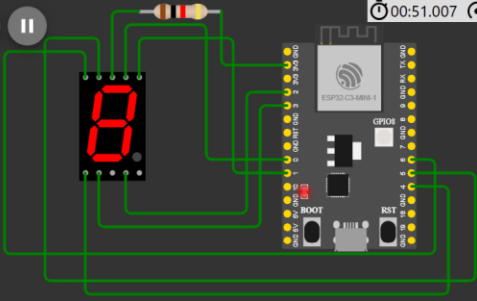
WOKWI
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SIGN UP

sketch.ino
diagram.json
sketch.S
Library Manager

```

10  init:
18  li a1, IO_MUX_GPIO4_REG
19  sw a2, 0(a1)
20  li a1, IO_MUX_GPIO5_REG
21  sw a2, 0(a1)
22  li a1, IO_MUX_GPIO6_REG
23  sw a2, 0(a1)
24  li a1, IO_MUX_GPIO7_REG
25  sw a2, 0(a1)
26
27
28  main_loop:
29  li a1, GPIO_OUT_REG
30  li a2, 0xc0
31  sw a2, 0(a1) # Output to GPIO
32  call delay_asm      # Delay
33
34
35  li a1, GPIO_OUT_REG
36  li a2, 0xf9
37  sw a2, 0(a1) # Output to GPIO
38  call delay_asm      # Delay
39
40
41  li a1, GPIO_OUT_REG
42  li a2, 0xa4
43  sw a2, 0(a1) # Output to GPIO
44  call delay_asm      # Delay

```

Simulation
00:51.007 99%


```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```

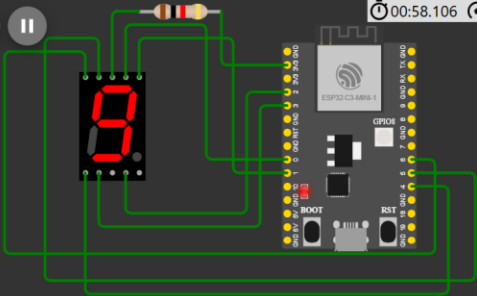
WOKWI
SAVE
SHARE
vu
Docs
SIGN UP

sketch.ino
diagram.json
sketch.S
Library Manager

```

10  init:
18  li a1, IO_MUX_GPIO4_REG
19  sw a2, 0(a1)
20  li a1, IO_MUX_GPIO5_REG
21  sw a2, 0(a1)
22  li a1, IO_MUX_GPIO6_REG
23  sw a2, 0(a1)
24  li a1, IO_MUX_GPIO7_REG
25  sw a2, 0(a1)
26
27
28  main_loop:
29  li a1, GPIO_OUT_REG
30  li a2, 0xc0
31  sw a2, 0(a1) # Output to GPIO
32  call delay_asm      # Delay
33
34
35  li a1, GPIO_OUT_REG
36  li a2, 0xf9
37  sw a2, 0(a1) # Output to GPIO
38  call delay_asm      # Delay
39
40
41  li a1, GPIO_OUT_REG
42  li a2, 0xa4
43  sw a2, 0(a1) # Output to GPIO
44  call delay_asm      # Delay

```

Simulation
00:58.106 97%


```

rst:0x1 (POWERON),boot:0xc (SPI_FAST_FLASH_BOOT)
SPIWP:0xee
mode:DIO, clock div:1
load:0x3fcd6100,len:0x420
load:0x403ce000,len:0x90c
load:0x403d0000,len:0x2370
entry 0x403ce000

```